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THE IMPACT OF SCIENCE UPON SOCIETY[1]

By Sir JOSIAH STAMP

SCIENTISTS see very clearly how, if politicians were more intelligent, if business men were more disinterested and had more social responsibility, if governments were more fearless, far-sighted and flexible, our knowledge could be more fully and quickly used to the great advantage of the standard of life and health—the long lag could be avoided, and we should work for social ends. It means, says Mr. Julian Huxley, "the replacement of the present socially irresponsible financial control by socially responsible planning bodies." Also, it obviously involves very considerable alterations in the structure and objectives of society, and in the occupations and preoccupations of its individuals. Now a careful study of the literature of planning shows that it deals mainly with planning the known, and hardly at all with planning for changes in the known. Although it contemplates "planned" research, it does not generally provide for introducing the results of new research into the plan, and for dealing with the actual *impact*—the unemployment, redirection of skill and location and the breaking of sentimental ties that distinguish men from robots. It seems to have not many more expedients for this human problem than our quasi-individualist society with its alleged irresponsibility. It also tends to assume that we can tell in advance what will succeed in public demand and what will be superseded. There is nothing more difficult, and the attempt to judge correctly under the intellectual stimulus of high profits and risk of great losses is at least as likely to succeed as the less personally vital decision on a committee. Would a planning committee, for example, planning a new hotel in 1904, have known any better than capitalist prevision that the fifteen bathrooms then considered adequate for social demand ought really to have been ten

[1] Concluding part of the address of the president of the British Association for the Advancement of Science, Blackpool, September 9, 1936.

times that number if the hotel was not to be considered obsolete thirty years later? Prevision thought of in terms of hindsight is easy, and few scientists have enjoyed the responsibility of making practical decisions as to what the public will want far ahead. They, therefore, tend to think of prevision in terms of knowledge and appreciation of particular scientific possibilities, whereas it involves unknown demand schedules, the unceasing baffling principle of substitution, the inertia of institutions, the crusts of tradition and the queer incalculability of mass mind. Of course, in a world where people go where they are told, when they are told, do what they are instructed to do, accept the reward they are allotted, consume what is provided for them and what is manifestly so scientifically "good for them" these difficulties need not arise. The human problem will then be the "Impact of Planning." I am not here examining the economics of planning as such, but only indicating that it does not provide automatically the secret of correct prevision in scientific innovation. When correct prevision is possible a committee can aim at planning with a minimum disturbance and wastage (and has the advantage over individuals acting competitively), but for such innovation as proves to be necessary it does not obviate the human disturbance or radically change its character. The parts of human life are coordinated and some are more capable of quick alteration than others, while all are mutually involved. One may consider the analogy of a railway system which has evolved, partly empirically and partly consciously, as a coordinated whole. Suddenly the customary speed is radically changed, and then it may be that all the factors are inappropriate—distance between signals, braking power, radius of curves, camber or super-elevation, angles of crossings, bridge stresses. The harmony has been destroyed. Especially may this be the case if the new factor applies to some units only, and not to all, when the potential density of traffic may be actually lessened. The analogy for the social system is obvious, and its form of government matters little for the presence of the problem, though it may be important in the handling of it.

I have spoken as though the normal span of life of men and machinery themselves provides a phase to which scientific advance might be adjusted for a completely smooth social advance. But this would be to ignore customs and institutions, even as we see in federal America, Australia and Canada, constitutions which lengthen that phase and make it less amenable as a natural transition. At one time we relied on these to bring about the economic adjustment necessary. But technical changes take place so rapidly that such forces work far too slowly to make the required adaptation. Habits and customs are too resistant to change in most national societies to bring about radical institutional changes with rapidity, and we patch with new institutions and rules to alleviate the effects rather than remove the causes of maladjustments. The twenty-mile speed limit long outstayed its fitness, and old building restrictions remained to hamper progress. Edison is reported to have said that it takes twenty-five years to get an idea into the American mind. The Webbs have given me a modal period of nineteen years from the time when an idea comes up as a practical proposition from a "dangerous" left wing to the date when it is effectively enacted by the moderate or "safe" progressive party. This period of political gestation may be a function of human psychology or of social structure. We do not know how ideas from a point of entry permeate, infiltrate or saturate society, following the analogues of conduction, convection or lines of magnetic force.

Our attitude of mind is still to regard change as the exceptional, and rest as the normal. This comes from centuries of tradition and experience, which have given us a tradition that each generation will substantially live amid the conditions governing the lives of its fathers and transmit those conditions to the succeeding generation. As Whitehead says: "We are living in the first period of human history for which this assumption is false." As the time span of important change was considerably longer than that of a single human life, we enjoyed the illusion of fixed conditions. Now the time span is much shorter, and we must learn to experience change ourselves.

I have so far discussed modification of impact to meet the nature of man. Now we must consider modifying the nature of man to meet impact.

Sociologists refer to our "cultural lags" when some of the phases of our social life change more quickly than others and thus get out of gear and cause maladjustments. Not sufficient harm is done to strike the imagination when the change is a slow one, and all the contexts of law, ethics, economic relations and educational ideals tend towards harmony and coordination. We can even tolerate by our conventions gaps between them when preachers and publicists can derive certain amusement and profit from pointing out our inconsistencies. But when things are moving very rapidly, these lags become important; the concepts of theology and ethics, the tradition of the law, all tend to lag seriously behind changes brought about through science, technical affairs and general economic life. Some hold that part of our present derangement is due to the lack of harmony between these different phases—the law and governmental forms constitutionally clearly lag behind even economic developments as impulsed by scientific discovery. An acute American observer has said that "the causes of the greatest economic evils of to-day are to be found in the recent great multiplication of interferences by government

th the functioning of the markets, under the influ-ce of antiquated doctrines growing out of conditions far more primitive economic life." It would be, rhaps, truer to say that we are becoming "stability nscious" and setting greater store, on humanitarian ounds, by the evil effects of instability.

In the United States it would be difficult to find, cept theoretically in the President, any actual per-n or instrument in the Constitution having any re-onsibility for looking at the picture of the country a whole, and there is certainly none for making a ordinated plan. Indeed, in democracy, it is difficult conceive it, because the man in public life is under ntinual pressure of particular groups, and so long he has his electoral position to consider, he can not t the general picture of progress in the forefront. hitehead declared that when an adequate routine, e aim of every social system, is established, intelli-ence vanishes and the system is maintained by a co-rdination of conditioned reflexes. Specialized train-g alone is necessary. No one, from President to iner, need understand the system as a whole.

The price of pace is peace. Man must move by tages in which he enjoys for a space a settled idea, nd thus there must always be something which is ather delayed in its introduction and the source of ectional scientific scorn. If every day is "moving" ay, man must live in a constant muddle, and create hat very fidget and unrest of mind which is the nega-ion of happiness. Always "jam to-morrow"—the to-norrow that "never comes." If we must have quanta r stages, the question is their optimum length and haracter, not merely the regulation of industry and nnovation to their tempo, but the education of man nd society to pulse in the same rhythmic wave-length r its harmonic.

In some ways we are so obsessed with the delight nd advantage of discovery of new things that we have o proportionate regard for the problems of arrange-ment and absorption of the things discovered. We are like a contractor who has too many men bringing materials on to the site, and not enough men to erect the buildings with them. In other words, if a wise central direction were properly allocating research workers to the greatest marginal advantage, it would make some important transfers. There is not too much being devoted to research in physics and chem-istry, as modifying industry, but there is too much relatively to the research upon the things they affect, in physiology, psychology, economics, sociology. We have not begun to secure an optimum balance. Addi-tional financial resources should be applied more to the biological and human sciences than to the applied physical sciences or possibly, if resources are limited, a transfer ought to be made from one to the other.

Apart from the superior tone sometimes adopted by "pure science" towards its own applications, scientific snobbery extends to poor relations. Many of the hard-boiled experimental scientists in the older and so pro-ductive fields look askance at the newer borderline sci-ences of genetics, eugenics and human heredity, psy-chology, education and sociology, the terrain of so much serious work but also the happy hunting ground of "viewey" cranks and faddists. Here the academic soloist is still essential, and he has no great context of concerted work into which to fit his own. But unless progress is made in these fields which is comparable with the golden ages of discovery in physics and chem-istry, we are producing progressively more problems for society than we are solving. A committee of popu-lation experts has recently found that the expenditure on the natural sciences is some eight to ten times greater than that on social sciences. There is hardly any money at all available for their program of re-search into the immense and vital problems of popu-lation in all its qualitative and quantitative bearings. An attack all along the front from politics and educa-tion to genetics and human heredity is long overdue. Leisure itself is an almost unexplored field scientifi-cally. For we can not depend wholly on a hit-and-miss process of personal adaptation, great though this may be. There must be optimal lines of change which are scientifically determinable. We have seen in a few years that the human or social temperament has a much wider range of tolerance than we had supposed. We can take several popular examples. The reaction to altered speed is prominent. In the "Greevey Papers," it is recorded that the Knowsley party ac-complished twenty-three miles per hour on the rail-way and recorded it as "frightful—impossible to divest yourself of the notion of instant death—it gave me a headache which has not left me yet—some damnable thing must come of it. I am glad to have seen this miracle, but quite satisfied with my first achievement being my last." In the British Associa-tion meeting for 1836, an address on "Railway Speeds" prophesied that some day fifty miles an hour might be possible. Forty years ago we may remember that a cyclist doing fifteen to eighteen miles an hour was a "scorcher" and a public danger. Twenty-five years ago, thirty miles an hour in motoring was an almost unhealthy and hardly bearable pace. To-day the fifties and sixties are easily borne, both by pas-senger and looker-on. Aeroplane speeds are differ-ently judged, but at any rate represent an extension of the tolerance. Direct taxation thirty years ago in relation to its effect on individual effort and action seemed to reach a breaking-point and was regarded as psychologically unbearable at levels which to-day are merely amusing. The copious protection of women's dress then would have looked upon to-day's rationality as suicidal lunacy. One hesitates to say, therefore,

that resistances to scientific changes will be primarily in the difficulty of mental and physical adjustments. But there can be little doubt that with the right applications of experimental psychology and adjusted education, the mind of man would be still more adaptable. Unfortunately, we do not know whether education as an acquired characteristic is in any degree inheritable and whether increasing educability of the mass is a mere dream, so that we are committed to a sisyphean task in each generation. Nor do we know whether this aspect is affected by the induced sterility of the age. It may not be a problem of changing the same man in his lifetime, but of making a larger difference between father and son. The latest teachings of geneticists hold out prospects for the future of man which we should like to find within our present grasp, and recent successful experiments with mammals in parthenogenesis and eutelegenesis bear some inscrutable expression which may be either the assurance of new hope for mankind or a devil's grin of decadence.

What is economics doing in this kaleidoscope? The body of doctrine which was a satisfactory analysis of society twenty-five years ago is no longer adequate, for its basic postulates are being rapidly changed. It confined itself then to the actual world it knew and did not elaborate theoretical systems on different bases which might never exist. It is, therefore, now engaged in profoundly modifying the old structures to meet these new conditions. Formerly it assumed, quite properly, a considerable degree of fluid or competitive adjustment in the response of factors of production to the stimulus or operation of price, which was really a theory of value-equilibrium. Wherever equilibrium was disturbed, the disturbance released forces tending to restore it. To-day many of the factors formerly free are relatively fixed, such as wage levels, prices, market quotas; and when an external impact at some point strikes the organism, instead of the effect being absorbed throughout the system by adjustments of all the parts, it now finds the shock evaded or transmitted by many of them, leaving the effects to be felt most severely at the few remaining points of free movement or accommodation. Unemployment is one of these. The extent to which this fact throws a breaking strain upon those remaining free points is not completely analyzed, and the new economics of imperfect competition is not fully written out or absorbed. The delicate mechanism of price adjustment with the so-called law of supply and demand governed the whole movement, but with forcible fixation of certain price elements consequences arise in unexpected and remote quarters. Moreover, the search for a communally planned system to secure freedom from maladjustments involves a new economics in which the central test of price must be superseded by a statistical mechanism and a calculus of costs which has not y been satisfactorily worked out for a community m taining *some* freedom of individual action and choi The old international currency equilibrated wor forces and worked its way into internal conditions order to do so. But the modern attempt to preve any internal effect of changes in international trad or to counteract them, and the choice of internal pri stability at all costs against variable internation economic equations, has set economic science a ne structure to build out of old materials. At thi moment when elasticity is most wanted, stability lead ing to rigidity becomes a fetish. The aftermath of wa is the impossibility of organizing society for peace.

The impact of economic science upon society to-da is intense and confusing, because, addressing itself t the logic of various sets of conditions as the likely o necessary ones according to its exponents' predilec tions, it speaks with several voices, and the public are bewildered. Unlike their claims upon physics and mathematics, since it is dealing with money, wages and employment, the things of every day, they have a natural feeling that it ought to be easily understandable and its truth recognizable. Balfour once said, in reference to Kant, "Most people prefer a problem which they can not explain, to an explanation which they can not understand." But in the past twenty years, the business world and the public have become economics-conscious and dabble daily in index numbers of all kinds and the paraphernalia of foreign exchange and statistics of economic life. The relativity of economic principle to national psychology baffles the economists themselves, for it can be said truly at one and the same time, for example, that confidence will be best secured by balancing the budget, and by not balancing it, according to public mentality. The economics of a community not economically self-conscious are quite different from those of a people who watch every sign and act accordingly. Thus the common notion that economics should be judged by its ability to forecast (especially to a particular date) is quite fallacious, for the prophecy, if "true" and believed, must destroy itself, inasmuch as the economic conduct involved in the forecast is different after the forecast from what it would have been before. The paradox is just here, for example: if a people are told that the peak of prices in a commodity will actually be on June 10, they will all so act that they anticipate the date and destroy it. Economics, thoroughly comprehended, can well foretell the effects of a tendency, but hardly ever the precise date or amount of critical events in those effects. The necessity for a concentration upon new theoretical and analytical analysis, and upon realistic research, is very great. But so also is the need for wide-spread and popular

teaching. For a single chemist or engineer may by his discovery affect the lives of millions who enter into it but do not understand it, whereas a conception in economic life, however brilliant, generally requires the conformity of the understanding and wills of a great number before it can be effective.

But not alone economics: if the impact of science brings certain evils they can only be cured by more science. Ordered knowledge and principles are wanted at every point. Let us glance at three only, in widely different fields: man's work, man's health, man's moral responsibility. The initial impact of new science is in the factory itself. The kind of remedy required here is covered by the work of the National Institute of Industrial Psychology. Some of this improves upon past conditions, some creates the conditions of greater production, but much of it combats the evils arising from new conditions created by modern demands, speed, accuracy and intensity. It invokes the aid of many branches of science. It is the very first point of impact. Yet its finance is left to personal advocacy, and commands not 10 per cent. of the expenditure on research in artificial silk, without which the world was reasonably happy for some centuries. We can judge of the scope of this by the reports of the Industrial Health Research Board. Again, the scientific ancillaries of medicine have made immense strides. Clinical medicine as an art makes tardy, unscientific and halting use of them. The public remains as credulous as ever, their range of gullibility widened with every pseudo-scientific approach. (We do not know what proportion of positive cases can create the illusion of a significant majority in mass psychology, but I suspect that it is often as low as 20 per cent.). For a considerable range of troubles inadequately represented in hospitals, the real experience passes through the hands of thousands of practitioners, each with too small a sample to be statistically significant, and is, therefore, wasted from a scientific standpoint. Half-verified theories run riot as medical fashions, to peter out gradually in disillusionment. If the scattered cases were all centralized through appropriately drawn case-histories, framed by a more scientifically trained profession, individual idiosyncrasy would cancel out, and mass scrutiny would bring the theories to a critical statistical issue of verification or refutation in a few months. This would be to the advantage of all society, and achieve an even greater boon in suggesting new points for central research.

A suggestion has been made for an inventions clearing house, to "cooperate the scientific, social and industrial phases of invention, and to reduce the lag between invention and application," managed by a committee of scientists and a committee of industrialists and bankers. The proposal came to me from New York, but London was to be the home of the organization, which was to adopt a code of ethics in the interests of inventors, industry and *social progress*. This brings me to my third example, the field of ethics, which needs the toil of new thought. The systems of to-day, evolving over two thousand years, are rooted in individualism and the relations between individuals. But the relations of society to-day are not predominantly individual, for it is permeated through and through with corporate relations of every kind. Each of these works over some delegated area of the individual's choice of action and evolves a separate code for the appropriate relationship. The assumption that ethical questions are decided by processes which engage the individual's whole ethical personality is no longer even remotely true. The joint stock company may do something, or refrain from doing something, on behalf of its shareholders, which is a limited field of ethics, and may but faintly resemble what they would individually do with all other considerations added to their financial interests. The whole body of ethics needs to be reworked in the light of modern corporate relations, from Church and company, to cadet corps and the League of Nations.

In no case need we glorify change: but true rest may be only ideally controlled motion. The modern poet says:

> The endless cycle of idea and action,
> Endless invention, endless experiment,
> Brings knowledge of motion, but not of stillness.

But so long as we are to have change—and it seems inevitable—let us master it. T. S. Eliot goes on:

> Where is the wisdom we have lost in knowledge?
> Where is the knowledge we have lost in information?

My predecessors have spoken of the shortcomings of the active world—to me they are but the fallings short of science. Wherever we look we discover that if we are to avoid trouble we must take trouble—scientific trouble. The duality which puts science and man's other activity in contrasted categories with disharmony to be resolved, gaps to be bridged, is unreal. We are simply beholding ever-extending science too rough round the edges as it grows.

What we have learned concerning the proper impact of science upon society in the past century is trifling, compared with what we have yet to discover and apply. We have spent much and long upon the science of matter, and the greater our success the greater must be our failure, unless we turn also at long last to an equal advance in the science of man.

SCIENTIFIC EVENTS

AGRICULTURAL RESEARCH AND MARKETING IN THE BRITISH EMPIRE

A CORRESPONDENT of the London *Times* reports that the British agricultural and marketing acts of 1931 and 1933, which empowered the boards concerned to make provision for education and research, provided facilities which have never existed before for securing information on practical problems.

Simultaneously with the organization of marketing, the government has established the Agricultural Research Council to exercise general oversight over the field of agricultural research. The Marketing Boards, closely associated with the Department of Agriculture, are in a position to express the problems of the industries they represent and to provide funds for their investigation. The Agricultural Research Council is in close association with the Department of Agriculture and with the Department of Scientific and Industrial Research and the Medical Research Council, and is in a position to ensure that problems that may arise are effectively attacked.

For the past two or three years the Milk Marketing Board, in addition to setting aside substantial funds for the economic investigation of milk production costs, has had an arrangement with milk buyers under which a fraction of a penny a gallon on milk bought and sold in May is allocated to research. This arrangement has made available for research purposes an annual sum of rather under £10,000. With this money investigations of practical import to the milk industry have been set on foot, after consultation with the Department of Agriculture and Agricultural Research Council. A large-scale investigation into methods of disposal of dairy effluents is being made by the Department of Scientific and Industrial Research; work on contagious abortion in dairy cattle is being carried out at certain centers under the supervision of the Agricultural Research Council; dairy cow nutrition and problems of cheese manufacture are being studied at the National Institute for Research in Dairying, Reading; and certain technical investigations of milk quality and safety are in progress at the London School of Hygiene.

In the pig and bacon marketing schemes research responsibilities are undertaken by the Bacon Development Board, which has been established only recently. One of the first acts of the board was to appoint a research officer who had extensive experience of research matters as well as considerable acquaintance with the practicable problems of the pig industry.

The board has already disbursed research money in certain directions. A food-recording scheme for pigs, in charge of the University of Cambridge, is being financed, for example, and a large-scale experiment designed to ascertain the effect of different transport distances on carcass quality is being made.

In the Sugar Industry Act the obligation is placed on the Sugar Commission to prepare and submit to the Minister for his approval a scheme of education and research into matters affecting the growing of home-grown beet, or the manufacturing, refining, marketing or consumption of sugar. The cost involved in the carrying out of such a program will be met by levies on the refiners, on the British Sugar Corporation and on home-grown beet growers, according to the extent of their interest in the scheme; it is roughly estimated that the maximum financial provision which will thus be made available may be in the neighborhood of, say, £70,000 a year. Hitherto the beet-sugar factories have been providing about £5,000 a year for education and research purposes, these funds being administered by a joint committee of the factories and the Ministry of Agriculture. The work has included research into questions of cultivation, manuring, pests and diseases, and seed strains, together with a scheme of prizes to growers.

AIRPLANE WEATHER OBSERVATION STATIONS

AIRPLANE weather observation stations have been added to the network that provides information on conditions in the upper air for use in making the daily weather forecasts, at Miami, Fla., at Sault Sainte Marie, Mich., at Salt Lake City, Utah, and at Oakland, Calif.

Each year since 1931, when kites gave way to planes for the daily sounding of the air, there has been a steady increase in the number of stations equipped to make airplane observations. The Army, the Navy and the U. S. Department of Commerce cooperate with the Weather Bureau in this work.

At the 12 airplane weather observation stations maintained by the Weather Bureau—Murfreesboro, Tenn.; Omaha, Neb.; Cheyenne, Wyo.; Billings, Mont.; Fargo, N. Dak.; Oklahoma City, Okla.; El Paso, Tex.; Spokane, Wash., and the four new ones—a pilot in a suitably equipped plane, furnished under government contract by a private flyer or flying company, goes up 16,500 feet into the air each morning, if possible. The plane carries an aerometeorograph—an instrument that automatically records the pressure, temperature and humidity of the atmosphere through which it passes. The pilot notes certain conditions, such as the time he enters or emerges from clouds, precipitation, ice formation on the plane, bumpiness

of the air and visibility. A Weather Bureau observer checks the accuracy of the aerometeorograph, fastens it to the airplane before each flight, makes the necessary meteorological observations at the earth's surface before and during the flight, and puts into usable form the records brought down by the aerometeorograph and the pilot.

At the eight army stations—Mitchel Field, Long Island, N. Y.; Selfridge Field, near Detroit, Mich.; Wright Field, Dayton, Ohio; Scott Field, Belleville, Ill.; Kelly Field, San Antonio, Tex.; Maxwell Field, Montgomery, Ala.; Barksdale Field, Shreveport, La., and Boston, Mass.—Air Corps pilots and planes, using Weather Bureau instruments, make the daily flights. Weather Bureau observers do the rest of the work. At the seven other stations—Lakehurst, N. J.; Anacostia, D. C.; Norfolk, Va.; Pensacola, Fla.; San Diego, Calif.; Pearl Harbor, Hawaii, and Seattle, Wash.—the navy provides all equipment and does all the work.

A country-wide teletype and radio communication service—nearly all operated by the Bureau of Air Commerce, U. S. Department of Commerce—make it possible to transmit airplane weather observations instantaneously to the stations where they are to be used. From two stations not yet on one of these circuits—Sault Sainte Marie and Maxwell Field—the observations are telegraphed to the nearest point on the teletype circuits. Observations taken at Pearl Harbor go by navy radio to San Francisco, where they are put on teletype circuits.

Airplane observation flights are made at about the same time all over the country—4:00 A. M., Eastern Standard Time, except when the weather is unfavorable, particularly when the ceiling (base of the clouds) is lower than 800 feet or when visibility is less than 2 miles. At each station the information compiled at the end of the flight is coded and sent out over a teletype or radio circuit, or first by telegraph, to the six district forecast centers and other stations of the Weather Bureau. Reaching these stations by 8:30 A. M., E. S. T., the data are plotted on various kinds of charts, which, in conjunction with charts of surface, pilot balloon and cloud observations, give the forecasters the information they need in making the daily weather forecasts.

COLLECTIONS OF WOODS OF THE WORLD AT YALE UNIVERSITY

PROGRESS in tropical forestry and the world-wide study of woods by the Yale Forest School is the subject of a report recently issued. The Yale wood collections now contain over 32,500 specimens, representing more than 10,400 named species of 2,548 genera and 225 families. The additions during the last two years alone almost equalled the total number of specimens on hand a decade ago.

The principal addition made to the collections was secured as a result of the visit of Professor Samuel J. Record to Holland. This consisted of a gift from the Commercial Museum of the Colonial Institute at Amsterdam of 2,215 Javanese wood specimens collected with herbarium material by Koorders during the years 1888–1894. This material was studied for more than 30 years by Dr. Janssonius of Holland, and the results of his work were published in six volumes. Students can now examine the actual material which is described in the text.

More attention in the future will be given to increasing the number of preparations for microscopic study. Last year, cross, radial and tangential sections of 973 specimens were added to the slide collections. These collections now contain slides of 5,235 specimens. Most of the slides have been received in exchange for wood samples, many of them coming from the Forest Research Institute, the Federated Malay States, the Imperial Forestry Institute, Oxford, the Biological Laboratories, Harvard, and the botanical department of the University of Michigan.

One of Professor Record's major projects has been the study of the timbers of British Honduras. The work was begun ten years ago in cooperation with the forestry department of the colony and with the Field Museum of Natural History. He collaborated in the authorship of a volume on this subject, published this year by the museum.

For the work in timber testing, it has been found advantageous to use specimens of little known but potentially important tropical trees, as the data thus obtained are contributions to science. Professor George A. Garratt has finished a paper on the trees known in British Honduras as "Waika Chewstick." It is planned to continue this work through arrangements with logging operators in tropical America.

Other activities include the building up of the herbarium, the identification of wood samples and the supplying of information to scientific men, timber dealers, wood users and to the general public.

MEETING OF THE FOUNDER SOCIETIES OF THE AMERICAN INSTITUTE OF PHYSICS

A JOINT meeting of the American Physical Society, the Optical Society of America, the Acoustical Society of America, the Society of Rheology and the American Association of Physics Teachers will be held in New York, from October 29 to 31.

This meeting, held at the time of the fifth anniversary of the American Institute of Physics, will consist partly of the regular papers of the separate societies and partly of sessions in which all the societies

will participate jointly. The joint sessions will emphasize the application of physics in the industrial world of to-day. Leaders in various fields have been invited to take part in symposia concerned with the training of physicists for industry and with the applications of physics in industry. While abounding in technical value, these symposia will be addressed to all who are interested in science, whether or not they are specialists in the fields discussed. Every effort is being made to arrange a program of exceptional interest.

The headquarters will be at the Hotel Pennsylvania, and all the meetings will be held at the hotel. Non-scientists as well as engineers and chemists are cordially invited to attend this meeting.

On Thursday morning Dean Homer L. Dodge will speak on the training of physicists for industry from the point of view of the educator, while Dr. A. R. Olpin, of Kendall Mills, will speak from the point of view of the industrialist.

The speakers for the symposium on "Physics in Industry," which will be held on Thursday afternoon and Friday morning, are Messrs. E. C. Sullivan, Zay Jeffries, Paul D. Foote, J. P. Den Hartog, John E. Burchard, O. E. Buckley, Clark B. Millikan and Joseph Slepian. The papers will cover many phases of applied physics. The individual societies are also planning feature programs which will be announced in the near future.

On Friday evening a large joint dinner meeting of all the societies will be held. As a special entertainment feature, John Mulholland, president of the Society of American Magicians, will perform.

RECENT DEATHS

DR. EDWIN OAKES JORDAN, professor emeritus of bacteriology at the University of Chicago, died on September 2 at the age of seventy years.

DR. BERNARD SMITH, director of the British Geological Survey and Museum of Practical Geology, London, died on August 19 at the age of fifty-five years. Dr. Smith joined the Geological Survey in 1906; in 1931 he was appointed assistant to the director, Sir John Flett, and in July, 1935, he succeeded him as director. Dr. Smith was awarded the Bigsby medal of the Geological Society in 1927 and was elected fellow of the Royal Society in 1923.

WILLIAM RINTOUL, for ten years manager of the research organization of Imperial Chemical Industries, Ltd., died on August 25 at the age of sixty-six years.

PROFESSOR BENJAMIN GEORGE CORMACK, emeritus professor of botany at the Anderson College of Medicine, Glasgow, died on August 12 at the age of seventy years.

PROFESSOR JULIUS TANDLER, head of the Russian Health Institute, Moscow, previously federal minister of health in Vienna and professor of anatomy at the University of Vienna, died on August 26. He was sixty-two years old. Dr. Tandler attended the first International Hospital Congress at Atlantic City in 1929. He returned to the United States last year and lectured at the Columbia-Presbyterian Medical Center and at Mount Sinai Hospital.

DR. LUIGI DEVOTO, professor of pathology in the University of Pavia, an authority on occupational diseases, died on July 20, aged seventy-two years.

THE recent death is announced of the geologist, Dr. Krishna Kumar Mathur, principal of the Science College, Benares Hindu University.

SCIENTIFIC NOTES AND NEWS

DR. T. WAYLAND VAUGHAN, who recently retired as director of the Scripps Institution of Oceanography, La Jolla, will make his home in Washington, D. C., where he will continue his oceanographic work in connection with the U. S. Geological Survey and the U. S. National Museum. Before going to La Jolla in 1925, Dr. Vaughan had been senior geologist in the survey and associate in marine sediments at the museum.

PROFESSOR WILLIAM ERNEST CASTLE, who joined the faculty of Harvard University in 1897 as instructor in zoology, becoming professor in 1908, and who retired with the title emeritus last spring, has joined the faculty of the University of California, where he plans to continue his work on genetics. He is expected to take up his residence at Berkeley next month.

AFTER serving as head of the department of zoology at Oberlin College for twenty-three years, Professor Robert A. Budington has requested that that office be transferred to Dr. Charles G. Rogers, professor of comparative physiology in the department. In other respects Dr. Budington will continue in the same relation as hitherto to the program of zoological instruction.

Nature reports that at the annual summer Conference of Advisory Plant Pathologists at the University of Leeds, Dr. Geo. H. Pethybridge, mycologist to

the Ministry of Agriculture and Fisheries for the last twelve years, and previously for many years in the Department of Agriculture in Ireland, was presented with a radio receiving set, as a mark of appreciation on the occasion of his approaching retirement from official service.

WE also learn from *Nature* that the following awards have been made by the Royal Aeronautical Society: the Silver Medal to B. N. Wallis, for his work on geodetic construction; the Simms Gold Medal to W. S. Farren, for his inventions of new methods of the measurement of drag and his designs of scientific apparatus for aeronautical research; the Taylor Gold Medal to E. F. Relf, for his paper read before the society on the compressed air tunnel; the Sir Charles Wakefield Gold Medal to C. R. Fairey, for his work on the development of flaps; the Busk Memorial Prize to R. P. Alston, for his paper read before the society on wing flaps and other devices as aids to landing. At a recent meeting of the Amulree Committee the following awards were made on the recommendation of the Council of the Royal Aeronautical Society: the British Gold Medal for Aeronautics, as already announced in SCIENCE, to Dr. Hugo Eckener for his technical achievements in lighter-than-air craft, and the British Silver Medal for Aeronautics to A. J. Rowledge, for his scientific achievements in the development of aircraft engines.

Industrial and Engineering Chemistry states that the John M. Goodell prize, annually awarded to a member of the American Water Works Association for the most notable contribution to the science and practice of water-works development as recorded in the journal of the association, has been given for the year 1935 to Mathew M. Braidech, senior chemist, Baldwin Filtration Plant, Department of Public Utilities, Cleveland, for his paper entitled "The Spectrographic Determination of Minor Chemical Constituents in Various Water Supplies in the United States." H. E. Jordan, of the Indianapolis Water Company, has been awarded the John M. Diven Memorial Medal for outstanding service to the association.

IN recognition of the work of Dr. Edwin E. Osgood, assistant professor of biochemistry at the University of Oregon, on the growing of bone marrow, the Oregon State Board of Higher Education has approved increased funds for additional help, working facilities, materials and salary, looking forward to the establishment of a department of experimental medicine at the University of Oregon Medical School when deemed advisable.

OFFICERS of the Royal Anthropological Institute elected at the recent annual meeting are: *President,* Dr. H. S. Harrison; *Vice-president,* Dr. H. J. Fleure; *Honorary Secretary,* Dr. R. W. Firth; *Honorary Treasurer,* H. Coote Lake; *Honorary Editor,* R. U. Sayce.

THE REV. CHARLES A. BERGER, of Woodstock College, Maryland, was elected president of the Eastern States Division of the American Association of Jesuit Scientists at the concluding session of the fifteenth annual convention held at Holy Cross College, Worcester, Mass. He succeeds the Rev. Henry M. Brock, of Weston College.

LEWIS M. HEADLEY, of the Johns Hopkins University, has been appointed associate professor of mechanical engineering at the Iowa State College. He has been in charge of instruction in machine design at the Johns Hopkins University for the past seven years, and last year served as consulting engineer for the Pennsylvania Railroad electrification project.

PROMOTIONS in the College of Letters and Science of the University of Wisconsin have been announced as follows: Dr. H. A. Schuette and Dr. V. W. Meloche, of the department of chemistry, to full and associate professorships, respectively; to associate professorships, Dr. I. S. Sokolnikoff, mathematics, and Dr. C. A. Herrick, zoology. Professor A. H. Uhl has been named director of the course in pharmacy. In the College of Agriculture, Dr. C. A. Elvehjem, of the department of agricultural chemistry, and Dr. Charles L. Fluke, of the department of economic entomology, have been promoted to full professorships, and Dr. M. R. Irwin, of the department of genetics, has been advanced to an associate professorship. In the College of Engineering, R. R. Benedict, L. C. Larson and K. F. Wendt have been named assistant professors.

DR. J. BROOKES KNIGHT has been appointed curator of Paleozoic invertebrate paleontology in the department of geology at Princeton University.

DR. JOHN CLYDE HOSTETTER, director of research at the Corning Glass Works, who supervised the casting of the 200-inch telescope mirror for the California Institute of Technology, returned to the United States on September 1 after attending the International Conference of Glass Technologists in London as the official delegate of the National Research Council.

DR. W. W. MCLAUGHLIN, chief of the Division of Irrigation of the U. S. Bureau of Agricultural Engineering, has sailed for Europe as a delegate from the United States Government to the International Snow Survey Conference, which opens at Edinburgh on September 14.

DR. AND MRS. K. M. MEISTER, of the Plant Breeding Experiment Station in Saratov, in southern Russia, are making a four-months tour of the United

States and Canada to study cereals and allied crops of the North American continent.

DR. HUGH CABOT, of the Mayo Clinic, Rochester, Minn., lectured at St. Thomas's Hospital, London, on August 24 and 25.

DURING the past academic year the Stanford Chapter of Sigma Xi held public meetings addressed by the following scientific men: Professor Ernest O. Lawrence, on "Atoms: New and Old"; Dr. C. B. Bridges, on "The Relation between Genes and Chromosomes," and Professor Ross G. Harrison, on "The Study of Growth and Development by Grafting Embryonic Tissue between Animal Species." The chapter initiated on May 28 twenty-eight members and thirty-one associates. The initiation address was delivered by Professor W. F. Durand, national president of Sigma Xi, whose subject was "The Place of Science in Civilization." Officers for the year 1936–37 were elected as follows: *President,* P. H. Kirkpatrick; *Vice-president,* S. B. Morris; *Secretary-Treasurer,* E. L. Grant, and *Assistant Secretary-Treasurer,* D. M. Whitaker.

THE new public health laboratory of the Board of Health of New York City will be dedicated with formal exercises on the afternoon of October 6. Addresses will be given by Dr. Thomas Parran, Surgeon-General of the United States Public Health Service; Professor C.-E. A. Winslow, of Yale University; Dr. William H. Park, founder and director emeritus of the laboratory; Dr. Charles Gordon Heyd, president of the American Academy of Medicine; Dr. Anna Williamson, for many years assistant to Dr. Park; Dr. George McCoy, director of the National Institute of Public Health; Dr. Augustus Wadsworth, director of the New York State Laboratory at Albany, and Mayor F. H. La Guardia. The laboratory has been built with $700,000 from funds appropriated by the Public Works Administration, of which thirty per cent. was an outright grant and seventy per cent. a long term loan. The laboratory will be known as the William Hallock Park Research Laboratory, in honor of its founder.

THE Committee on Scientific Research of the American Medical Association invites applications for grants of money to aid in research on problems bearing more or less directly on clinical medicine. Preference is given to requests for moderate amounts to meet specific needs. For application forms and further information, please address the committee at 535 North Dearborn Street, Chicago.

WILLIAM H. DUNHAM, of Evanston, Ill., has presented to the Field Museum, Chicago, his private herbarium, consisting of 2,000 mounted sheets of plants. This collection is said to be of much local historical interest, because many of the specimens were gathered in the Chicago area, principally along the north shore, beginning about fifty years ago. Many of them are from areas now covered by buildings, where all natural vegetation disappeared long ago. The herbarium also contains many plants from other parts of the United States.

THE Georgia Rehabilitation Corporation has deeded to the University of Georgia a tract of land of 1,900 acres, estimated to be worth about $50,000, bringing the total number of acres of the campus to 3,500. The College of Agriculture and the George Foster Peabody School of Forestry will use the land for experiments and demonstrations.

THE Plant Science Seminar held its annual meeting from August 17 to 21 at a camp in the San Bois mountains, nine miles north of Wilburton, Oklahoma. The next seminar will be held in the East, probably on the Jersey coast. Officers elected for 1937 are: *President,* Dr. L. K. Darbaker, University of Pittsburgh; *Vice-president,* Dr. Elmer H. Wirth, University of Illinois, and *Secretary-Treasurer,* Dr. Loyd E. Harris, University of Oklahoma.

IN the search for superior germ plasm for the improvement of live stock in this country, the U. S. Department of Agriculture has imported from England several animals of breeds and types that are mostly little known in the United States. The shipment, which supplements importations of cattle, horses and dogs from several European countries within the last year, includes 3 South Devon cattle, 4 large black hogs, 22 white Wyandotte chickens and 11 white Austrian turkeys. After undergoing the necessary period of Federal quarantine, the South Devon cattle will be used by the Bureau of Dairy Industry and the hogs and poultry for experiments by the Bureau of Animal Industry. The South Devon cattle, a large breed, are noted for both beef and milk production. Bulls and steers attain a weight of approximately 1,800 pounds and the best cows yield upward of 16,000 pounds of milk annually. The large black hogs were obtained in Suffolkshire. The white Wyandotte chickens were obtained from various points in England and are to be used in comparisons with the same and other breeds of the United States. White Austrian turkeys also were obtained from England. The breed is similar to the white Holland turkey raised to some extent in the United States.

THE *New York Times* writes that severe storms and fog have been seriously impeding the operations of the Bowdoin College Scientific Expedition. A gale destroyed the party's wind generator, which was used for a source of electric power, and damaged meteoro-

logical equipment. The expedition's cruising boat, *The Scientist,* was recently lost in the fog and darkness off Kent's Island. Losing its course because of a four-knot tide, the vessel was entirely dependent upon radio for navigation. Signals were erected to lead it to the anchorage. Dr. A. O. Gross, leader of the expedition, reported that during the last month fourteen days of fog were experienced. Considerable scientific equipment was reported injured by the 90 per cent. average humidity. The main objective, the establishment of a scientific station on the isolated sea island, has been realized. Elaborate recording instruments have been installed to obtain weather information. An observer will operate this equipment during the winter, when the island is practically cut off from the rest of the world.

The Cornell Alumni News states that Dr. Frederick Bedell, professor of physics at Cornell University, on July 31 won a decision of a judicial referee in his suit against the Dictograph Products Company, Inc., to recover royalties and other payments amounting to more than $90,000 for the use of a bone conduction hearing device which he had perfected. Trial began last March 9 after almost a year of preliminary skirmishing between opposing counsel. A patent received by Professor Bedell is noted by the referee as proving that the instrument in question is, as claimed, a new invention.

THE department of physics of the University of Toronto in cooperation with the Meteorological Service of Canada offers a course in meteorology leading to an A.M. degree. It is open to graduates of recognized universities who have specialized in mathematics and physics, and consists of lecture courses in mathematics, applied mathematics, physics and dynamic meteorology, together with practical work in the use of meteorological instruments and weather forecasting. These sessions run from October 1 to May 24.

IN order to coordinate four hitherto separate collections, a Museum of Natural History has been created for the University of Oregon and the Oregon state system of higher education. Combined will be the formerly independent museum collections consisting of the Condon Museum of Geology, Herbarium, Oregon State Museum of Anthropology and Museum of Zoology, with Dr. L. S. Cressman as director. This organization will integrate the activities of the different parts and make more effective their use in the educational program of the University of Oregon. Although each unit is to retain its identity and have its own curator, the four units are to be coordinate for administrative purposes, have one budget and one administrative officer.

AT a meeting held on July 8, the board of trustees of the Colorado State Medical Society, according to the *Journal* of the American Medical Association, approved the establishment of the Colorado Medical Foundation. The plan to organize the institution was adopted at the 1935 meeting of the society, when authority for its creation was granted to the board of trustees by the House of Delegates. Its objective is to serve as a sound financial background for the membership of the society and its income "shall be used exclusively for charitable or educational purposes and the necessary expenses incident thereto." Although the fund is now small, *Colorado Medicine* points out, it is provided that until the foundation reaches the sum of $100,000, not more than 10 per cent. of its net annual income may be turned over to the treasurer of the state medical society for expenditure. After it reaches $100,000 and until it reaches $1,000,000, up to 50 per cent. of the net annual income may be utilized. After it reaches the million dollar figure, the portion of the income to be used, and the amount to be left in the fund to accumulate, will be determined by the officers and trustees of the society. The principal of the fund will never be expended. Any donor to the fund, however, may stipulate how his contribution may be expended and whether the principal and income shall be used in full or in part.

A CORRESPONDENT of the *Journal* of the American Medical Association writes that the work of installation at the center for the study of leprosy is proceeding rapidly. This institution has been established in accordance with an arrangement between the League of Nations and the Brazilian government with the philanthropic cooperation of Dr. Guilherme Guinle. Its inauguration recently took place at the office of the secretary of the exterior in the presence of high authorities, of the specialists on the staff of the new institution, and of the representative of the League of Nations, Dr. Etienne Burnet. The preparatory work of the International Center of Leprology has been started. The center is already organized with its complete personnel, having its seat at the Instituto Oswaldo Cruz, the director of which is Professor Carlos Chagas, who is also director of the International Center of Leprology, and with the installation of a pavilion especially constructed for this purpose at the Hospital-Colonia of Curupaity, in Jacarépaguá, a leprosarium exclusively erected for the sick of the federal district and under the direction of the national department of public health. This new pavilion has two stories with wards for two and four patients and a capacity of fifty patients, large verandas and recreation and lecture rooms. On the first floor are the consultation room and treatment rooms. The non-contagious cases of the disease will be treated in private clinics, leaving the beds in the leprosarium

for the isolation of the contagious cases. In the Hospital-Colonia of Curupaity is the section of clinical and experimental therapeutics. The school of Curupaity owes its importance in the center to the visit made to the colony in 1931 by Professor Nocht, well-known German expert, who went to Brazil for the League of Nations subsequent to the original proposition made by Professor Chagas.

DISCUSSION

CONCERNING FALLING CHIMNEYS

OCCASIONALLY one sees a photograph of a tall chimney caught in the act of falling to the ground. A characteristic feature of the fall is that the chimney may crack in mid-air soon after it starts to topple over, but the top of the chimney is observed to break *backward* instead of forward. The same phenomenon sometimes accompanies the felling of a tall tree. One may be tempted to speculate upon the cause of this peculiar behavior, for on first thought one might expect the top of the falling chimney to break over and fall forward. However, if the motion is considered as a *rotation* taking place about an axis at the base, it is evident that the break must be closely associated with the moment of inertia of the falling object. A simple analysis shows that, since all points of the chimney are moving with angular acceleration along the arcs of circles prior to the break, the center of percussion of the chimney is the point which has the natural acceleration of a particle moving under gravity along the same path. All parts of the chimney below its center of percussion are retarded; all parts above move with acceleration *greater* than they would have if constrained to move along the same paths under gravity alone. Hence there is an inertial reaction of the upper portion of the chimney which is opposite to the direction of motion, and the top lags behind. Breaks, if they occur at all, appear first above the center of percussion (Fig. 1a). Air

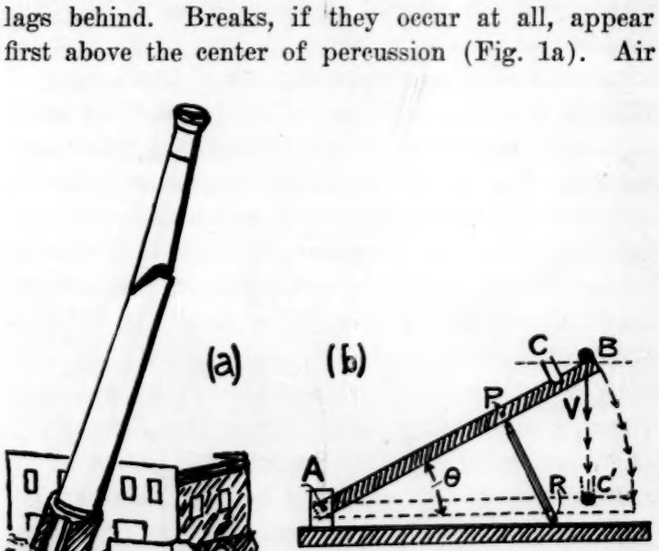

FIG. 1

resistance plays only a minor part, for such breaks develop before speeds commonly encountered in windstorms are reached. The gist of the matter is simply that the top of the chimney, barring such a break, would reach the ground sooner than could a freely moving particle traversing the same path under gravity alone. One might say that the "weight" of the upper portion of the falling chimney is effectively directed backward.

No doubt such an explanation of this interesting phenomenon is well known to engineers. However, two simple demonstrations have occurred to the author to illustrate the fact that the upper end of a toppling object moves with a linear acceleration greater than gravity would impart to a freely moving particle on the same path. The first illustration is effected with very limited facilities: simply take a meter stick and any heavy object, such as a paper weight. Support the object upon the right end of the stick while holding it horizontally with the index fingers of both hands. Release both ends at once, whereupon the stick and the object will be seen to fall together. Repeat the experiment, but this time place the index finger of the left hand *under* one end of the stick so that when the stick is released at the right end it will be forced to rotate about the left forefinger while falling. One might expect that since the left end of the stick is now restrained from falling, the right end would descend with vertical acceleration less than g and that the freely falling object would maintain contact with the right end of the stick or even get ahead of it. But the stick falls away from the object!

The second illustration is effected by means of a simple but entertaining gadget. A uniform stick AB (Fig. 1b) of any length (50 to 100 cm is convenient) is pivoted freely at A about a horizontal axis. At the end B there is bored a slight indentation just deep enough to retain a half inch steel ball. A light paper cylindrical cup is attached to the stick at C, where AC is 0.85 AB. The cup itself can be about 0.10 AB in height. Prop the stick AB by a lead pencil PR (eraser end at R to prevent slipping) in such a position that B is vertically above C′, the position occupied by C when the stick is horizontal. If, now, the prop is suddenly knocked out and the stick AB is allowed to fall, the freely falling ball B will drop into the cup! The whole motion is so rapid that the eye can scarcely follow it, but it proves conclusively that the end of the stick descends with vertical acceleration *greater than the acceleration of gravity.* The only condition imposed is that the angle θ shall not be too

at (less than 35°), and one must be careful not to rease the moment of inertia of the stick by the dition of a heavy cup at C. The prop PR should so placed that it does not impart an upward motion AB when struck.

The motion offers an interesting problem of analysis the student of mechanics. In the case of a uniform k where the center of percussion for axis A is at P P=2/3 AB) the acceleration of P along its circular th is g cos θ; therefore the tangential acceleration the end B is 3/2 g cos θ. The *vertical* component of the end B is 3/2 $\cos^2\theta$; hence when $\cos^2\theta$ is eater than 2/3 the vertical component of end B is eater than *g*. This condition is satisfied for all gles θ less than 35°, in which case a ball placed at will not fall so rapidly as the stick and the ball may made to plummet directly into the cup. Obviously, the case of a tall chimney, the heavy construction the lower portions brings the center of percussion closer to the base and exaggerates the effect which is monstrated in this simple case of the rotating stick.

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ORIENTAL PLANE TREE DISEASE

IN a study of the Hyphomycetes in North America[1] called attention to a species of *Acrosporium* Oidium) attacking the leaves of *Platanus orientalis* in Pittsburgh. Without specific name, the follow- g description was given: Amphigenous, white, fused, forming a dense stratum on the leaf; myce- um branched, interwoven; sporophores erect, single, ptate; spores smooth, ellipsoid, granular within, 5–27 × 40–50 μ.

During the past three years, I have collected the me plant on the same host in Philadelphia, Atlantic ity and near Gettysburg. The plant attacks both the oung and the older leaves. The leaves are disfigured d made unsightly. A white floccose stratum cover- g the entire leaf or part of the leaf readily distin- uishes the fungus. When the plant is once known can be recognized at a distance of several hundred eet. It may become a dangerous shade tree disease. he fungus belongs to the genus containing the co- idial stages of the Erysiphaceae. I have not been ble to find the perfect stage of this particular plant. Mr. John A. Stevenson, mycologist in the Depart- ent of Agriculture, Washington, D. C., to whom pecimens were sent, has compared the specimens with aterial in the Washington Herbarium. It seems to gree with a plant described from Louisiana on *Quer- us* and also from West Virginia on *Platanus* under he name *Oidium obductum* Ellis and Langlois.[2] Mr. Stevenson also calls attention to the fact that Salmon combines *Oidium obductum* with *Phyllactinia corylea*, as variety *angulata*.[3]

The name of this fungus is still uncertain. Specimens of the conidial stage to determine its distribution and of the perfect stage, if found, will be gladly received.

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PIGMENTS OF THE OAT COLEOPTILE

THE light-growth and phototropic responses of *Avena sativa* coleoptiles are evoked almost exclusively by wave-lengths below 550 mμ.[1,2] The spectral sensitivity rises sharply at about 500 mμ and appears to possess at least two maxima, at 430–440 mμ and at 465–480 mμ.[2] It is probable that light influences initially a pigment, the absorption spectrum of which exhibits similar properties. This type of spectrum is characteristic of carotenoids.

In oat seedlings of the "Victory" strain (Siegeshafer), grown in darkness, the first leaf is yellow, due to carotenoid pigments, while the coleoptile appears to be quite colorless. Ethanol or ethanol-ether extracts of several hundred coleoptiles, however, are light yellow. Their pigments, partitioned between 90 per cent. methanol and benzine, separate into the familiar epiphasic carotene and hypophasic xanthophyll fractions. Estimated colorimetrically, from 0.5 to 0.9 γ of xanthophyll, and from one seventh to one third as much carotene, were obtained per 100 coleoptiles, 1.5 to 3 cm in length.

In groups of seedlings which had been exposed intermittently to red light, chlorophyll developed in the first leaf. In these cases small quantities of chlorophyll were found also in the coleoptile.

The *Avena* coleoptile therefore possesses the same pigments as the leaf, though in much lower concentrations. Its photosensitive system, like those of all other plant and animal organs so far investigated, is associated with the presence of carotenoids.

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FLOOD CONTROL IN CONNECTICUT

MUCH serious thought has been given to the matter of preventing destruction by floods in the Connecticut Valley, especially since the bitter experience of 1936. One plan of control, a study of which has been di-

[1] *Mycologia*, 5: 58–59, 1913.
[2] *Jour. Myc.*, 6: 35, 1890.
[3] *Ann. Mycol.*, 3: 493–505, 1905.
[1] A. H. Blaauw, *Rec. trav. bot. néerl.*, 5: 209, 1909.
[2] F. Bachmann and F. Bergann, *Planta*, 10: 744, 1930; E. S. Johnston, *Smithsonian Misc. Collec.*, 92: 11, 1934; C. Haig, *Biol. Bull.*, 69: 305, 1935.

rected by Colonel Mason J. Young, of the Army Engineers, is of particular interest in that it looks down stream for relief and not to the hills, as is usual.

Due to the work of glaciers in the region of Middletown the Connecticut River has left its former channel and now follows for a distance another course never intended for its use. This results in three bad features: (1) A lengthened course; (2) an impeding curve; (3) the constricted channel, the "Narrows." These act as a veritable dam at this point in the river, causing the water to back up at Middletown, Portland, Hartford and even to Windsor Locks, a distance up stream of some twenty-five miles. Throughout most of this length the river had a fall in the recent flood of less than three inches per mile, while at the place where it is retarded it had a potential fall of more than three feet per mile.

It seems a simple thing, therefore, both in theory and in the execution to restore the river to its ancient channel with the expected results of, first, a quicker disposition of all flood waters, second, some five feet less flood at Hartford and, third, the saving of millions of dollars of property from destruction.

It is not our privilege here to discuss other plans for flood control, some of which certainly have their place in any scheme for protection. Some of these proje are expensive in view of the benefits expected; ma of them are of decreasing effectiveness with increasi flood height; most of them carry with them hazar that, beyond a certain point, may add to the d structiveness of the flood. A spillway such as we co template would be the more effective the greater t flood. Floods can not occur when there is adequa drainage down stream.

It is believed that the restoration of the river to proper course could be accomplished most expedien by opening up a mere trench east of the Portland Hi where indeed the river itself came within a couple miles of achieving the desired results; then we wou leave the main excavating work to the flooding wate themselves. One good flood—and the water rises twenty feet at Hartford three out of every four yea —might thus be turned to a useful purpose and its own disadvantage.

A better appreciation of the setting of this proje may be had from an examination of the Middleto Quadrangle of the United States Geological Survey.

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SCIENTIFIC BOOKS

A SCIENTIFIC ENCYCLOPEDIA

Hutchinson's Technical and Scientific Encyclopaedia. Edited by C. F. TWENEY and I. P. SHIRSHOV. Macmillan Company, New York. No date (published during 1935–36), 4 volumes, 2468 pages.

A MONTH'S use of this four-volume compendium has left the reviewer with mingled feelings: chiefly those of gratification that so useful a work is now available and of awe at the size of the completed task, but also of regret at the numerous minor faults which are present.

Before deciding on the worth of such a work, one must first of all decide as to what needs it is to satisfy and as to what sort of people will use it most. In covering a field as broad as the whole of modern technology and science, many choices must be made between different methods of exposition, and many subjects must be omitted completely. A work which is useful as an expanded dictionary, giving mostly definitions and short descriptions in semi-technical language and serving as a starting point for further reading in more detailed texts, will serve a quite different purpose than an encyclopedia for the general layman, giving the fundamental facts and principles of each subject in simple language. Choices of this sort had naturally to be made by the editors; and it is only fair to them, and to the reader, to judge the work from the point of view of their decisions.

Ordinarily, the editor's purpose could be determine from the preface; but in the present case there is n preface, so their purpose must be ascertained from th text itself. In the reviewer's judgment, the Encycl pedia is really an expanded dictionary of technolog and science, primarily defining and describing tec nical terms and usages, and only secondarily elucida ing general concepts. As such, it is an excellent an much-needed contribution and should be extreme useful to librarians and to scientific and technic workers wishing to study in fields somewhat outsi their own.

The selection of material has been almost wholl from the point of view of the practical engineer; ver little pure science or scientific theory is included. Fo instance, the article on sedimentary rocks takes up bu 14 lines; and there is no mention of the polar fron theory of meteorology. The whole subject of atomi theory is dismissed in the following surprising man ner: Under the item "Quantum Theory" is simply th reference "See Wave Mechanics"; and there is n item "Wave Mechanics." Those theoretical discus sions which do appear are rather fragmentary, an in a few cases (under Pyrometers, for instance), ar misleading.

The exclusion of theoretical subjects is quite allowe, however, although the publisher's claim on the ket that "the work traverses the whole field of ysics, Astrophysics, Meteorology, . . ." is rather leading. After all, one can not cover all the ects of science and technology in four volumes, a work traversing the field of *applied* physics, *plied* meteorology, etc., is a useful and welcome dition to any library.

The material on electrical engineering, on the other d, is satisfyingly complete, particularly in the field communication engineering (in fact, the best arles in the work seem to be in this field). There are d articles on filters, microphones and sound reprotion, to mention a few. There are also many good cussions of photography and of the allied arts of ocess engraving, motion picture photography and on. The fields of organic chemistry and chemical gineering are well represented, the properties and eparation of innumerable organic compounds being ted.

To pick a few items at random: there are interesting ticles on hormones, internal combustion engines, ternators, glass, vitamins, cotton, escapements, emoglobin, telephony, metallography and calculatg machines; though this last article neglects any scussion of integrating devices or electrical methods. The bibliography, consisting of about 3,000 refer-ces, is, on the whole, satisfactory and up to date; hough the inclusion of more German and American les (along with the English ones) would have made more representative. For instance: the list of books acoustics is quite complete, except that no German le is included; on the other hand, of the fifty titles ted under physics, only one book published after 30 is mentioned. The listing of some of the titles curious, to say the least: for instance, books on omic and nuclear physics are placed under chemry. For that matter, some of the items in the main ork are placed in rather incongruous categories. or example, the item "Cathode Sputtering" is belled as belonging to the field of acoustics.

The book is well printed, though the publisher could ve chosen a more readable type. The usefulness of e work for quick reference and for the non-technical erson is unfortunately reduced by a number of minor ults which could easily have been remedied. Many ore cross references could have been introduced, hich would have eliminated much hunting for items ithout materially increasing the size of the volumes. the long articles, more section headings and imortant words could have been printed in boldface or alics, to obviate the necessity of scanning the whole rticle to find a single item. Full captions could have been used for all illustrations, to reduce the amount of study needed to correlate cut- and subject-matter. For instance, stainless steel is not listed, though it is discussed in the article on chromium—not very helpful unless one knows the composition of stainless steel. Also, in looking up "Equilibrium Diagram," one is referred to "Metallography" (no subdivision title given), where one must look through five pages of text to find the word mentioned, referring to a Fig. 10, which is without caption. If Fig. 10 had had a caption, the item could have been more easily discovered, and the significance of the figure would be more obvious. Again: on page 3211 in the article on thermionics, the caption on Fig. 11 refers only to pentode characteristic curves, although the figure actually shows tetrode curves as solid lines and pentode curves only as dotted lines.

In spite of these minor flaws, the Encyclopedia should be of considerable interest and value to the layman; for although most of the articles are written in fairly technical language, most of the terms are defined somewhere in the text. There may be possible confusion arising from the fact that English terminology is used (cinema, acceptor circuit, etc.), which differs from American usage at times, particularly in the field of electrical engineering. The difficulties will not be serious, however, except perhaps for reference librarians. There are a large number of well-printed photographs and line drawings, which add to the interest and clarity of the articles, especially for the layman.

Even a casual perusal of these volumes will impress both layman and technical worker with the tremendous development of applied science in the past twenty years. Here is material for both sides in that purely academic battle concerning the benefits and dangers of science. Literally hundreds of the article titles are new words, invented within the last two decades to describe methods or machines invented during that time. Many more titles are old words with new meanings.

Especially impressive is the evidence of the revolution caused in nearly all branches of engineering by the vacuum tube. Articles on its applications are sprinkled throughout the four volumes. A scientific toy before the war, it has now replaced nearly all mechanical devices for the measurement of small quantities and for the transferring of small motions. In combination with the photoelectric cell or with the microphone, it performs, automatically, tasks hitherto impossible except by human means—often impossible by any means.

All these developments are most graphically illustrated in the pages of the Encyclopedia. Its editors are to be congratulated on having completed so huge

a task and on having produced so interesting and useful a work.

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AMERICAN AGRICULTURE IN 1936

Year Book of Agriculture—1936. Printed by the U. S. Government Printing Office. For sale by the Superintendent of Documents—price $1.25 cloth. 1936.

THE old Annual Report series of the Department of Agriculture was divided in 1894, as the result of legislative action, into two parts, one, the purely business and executive matters, and two, the annual survey of the department's work by the secretary and popular scientific papers calculated to be of interest to farmers. The second series was named the Year Book. In addition to the papers mentioned, the Year Book contained in an appendix statistical matter in reference to agriculture. This had grown to several hundred pages and, while highly useful, was somewhat out of place in this type of publication. Hereafter, statistical matter, with the exception of a few pa of general statistics, is to be published as a separ volume and is not included in the Year Book 1936. Aside from the general review of the agri tural situation and the work of the department, by secretary, the book is devoted to a survey of pl and animal breeding with special reference to "su rior germ plasm."

It is a useful historical review of work that h been done in these fields, with special emphasis on genetic and cytological aspects. A glossary of gene terms is included.

The treatment is largely historical, leading up the objectives now dominant and the improved te niques now available. The material for the ger plasm part of the book was assembled by the Co mittee on Genetics.

The book should be helpful to plant and anim breeders and to students interested in these gene subjects. With the index it includes 1,189 pages.

A. F. Woos

SPECIAL ARTICLES

THE INDIANA GROUP IN AMERICAN MEN OF SCIENCE[1]

IT seems fitting at this half century meeting of the Indiana Academy of Science to make a survey of the men of science produced in this state and also of those from other states who now make Indiana their home. In order to do this one's mind turns naturally to Cattell's "American Men of Science," published in 1933. It would certainly be interesting to see what part Indiana has played in furnishing her quota of the 22,000 scientists noted in this edition. Indiana is noted for her fertile acres, and "out where the tall corn grows" is a favorite expression which not only locates but also stresses the fertility of our state. The lack of large cities in the state means that her 3,238,503 residents of 1930 are scattered in small centers and country communities. It is noted in the summary of "American Men of Science" (1932) that Ohio and Indiana have in residence less than half of the leading men of science they have produced. Hence, there must be some reason conducive to such results, for it surely could not be just a matter of accident.

GROUPS INCLUDED IN THE STUDY

It was decided to limit this study to three groups, namely: First, those born in Indiana; second, those who spent four years in Indiana colleges and have secured the bachelor or equivalent degrees from Indiana colleges; and third, those from other sta who now make their home in Indiana. If those w spent from a few months to a few years, do graduate work, were included, it would add consid ably to the total number involved but would only te to complicate matters and make an interpretation the data more difficult. It was found that India has a total of 1,109 out of the 22,000 names of sci tists, or about 5 per cent. In order to get some inf mation bearing on the early life of those of the 1,1 who were born in Indiana, they have been grouped Table 1 according to the size of the town in wh

TABLE 1

NUMBERS AND PER CENT. BORN IN LARGE, MEDIUM AND SM TOWNS OR COUNTIES OF INDIANA

(1) Small town or county (under 1,000)	440	or 61.6 per c
(2) Medium size town	190	or 26.6 "
(3) Large towns (over 50,000)	84	or 11.8 "
Total	714	or 64.4 "

they were born. On this basis of Indiana's populati of 3,238,503 in 1930, this amounts to one native-bo scientist to every 4,534 citizens, or counting the 1,1 scientists belonging to the Indiana group, there is o scientist for every 2,920 persons. It has been es mated by Dr. A. D. Little in "The Fifth Estate" th it costs the state about $500,000 to find and develo a man to the extent that he is capable of advanci science. If this is the truth, it means that Indiana h spent about 500,000 times 714 or $357,000,000 for t

[1] Presented at the fiftieth meeting of the Indiana Academy of Sciences.

omotion of science. This has been a splendid investment, since "wealth is the product of brains, and bor is productive only as it is guided by intelligence."

The College Group of Scientists

In a study of the graduates holding bachelor degrees om Indiana schools, it was noted that there are 640, hich is 57.7 per cent. of the 1,109 scientists connected ith the state. These were found to be distributed ong the different institutions of the state as shown Table 2.

TABLE 2

The Number and Distribution of Scientists Among Indiana Colleges

diana University	240	Butler	19
rdue	151	Notre Dame	10
abash	58	Hanover	10
Pauw	54	Franklin	4
rlham	46	Marion	3
lparaiso	30	Ind. Central College ...	3
d. State Normal	22	Total	640

Choice of Occupations

It was but natural to lay stress in different degrees n certain branches in the different colleges depending n natural advantages of location or personality of achers. Thus, the inspiring personality and genius David Starr Jordan as teacher and investigator, r example, left a trail of enthusiasm for zoology hich is still much in evidence. All the schools at one me or another have had inspiring personalities who fluenced their students to follow their speciality. hese choices are evident to some extent in the number choosing the different professions, as shown in able 3.

TABLE 3

Choice of Occupation of the 1,109 Indiana Scientists

hemistry	236	Animal and Dairy Husbandry	22
ysics	125	Agronomy	18
gineering	90	Astronomy	18
hilosophy, ducation, sychology	74	Horticulture	18
		Pharmacy	16
otany	72	Agriculture	11
athematics	71	Nutrition, Home Economics ...	9
ology	50	Metallurgy	9
eology, eteorology	50	Pathology	9
edicine	49	Soils	8
lant Physiology and Pathology	41	Embryology, Histology	5
ology	39	Forestry	5
acteriology	30		
arasitology, ntomology	29	Genetics	5
		Total	1,109

It is probable that the recent great industrial development and world war were largely responsible for e great call for chemists—hence, the number noted.

Present Distribution of Indiana Scientists

A study of the present location of the 1,109 scientists reveals that only about one third of them or 329 re now living in Indiana and only 46.1 per cent. of those born in Indiana are now in the home state. This indicates that Indiana has furnished other states over twice as many scientists as are living in the state. Since 61.6 per cent. of these came from small towns and country districts, it looks as if it takes the open country with its rugged people to produce that degree of vision, trained intelligence, open-mindedness and persistence required to become a scientist. The distribution of part of the 1,109 scientists among 15 states in order of their numbers is as follows: Indiana 329, New York 83, Illinois 79, Pennsylvania 59, California 54, Washington, D. C. 53, Ohio 50, Michigan 31, Wisconsin and Massachusetts, 24 each, Texas 19, Connecticut 16, North Carolina 13, Tennessee and Washington, 12 each.

It is evident that the South and West (except California) have not had the attraction that the East has afforded.

Average Age of Indiana Scientists

The age of these scientists is of importance in this study. In the last fifty years, Indiana has been becoming less rural or has had a greater concentration of residents in cities than ever before. It was found that the average age of the 1,109 scientists was 47, or they were born in 1887, a time when a greater rural population existed than at present, but even at that time it was estimated to be only 62 per cent. in cities. Hence, most of the people lived in cities even then and ought to have supplied most of the scientists. This they failed to do.

Women Scientists and Starred Names

Among the 1,109 names, it was found that at least 31 were women. Some of the female names may not have been recognized, due to their similarity to those of men. However, this would not change the total of 1,109. There are also 27 names in the group starred, indicating famous scientists. These starred names are probably worthy of their fame, but it seems to the writer that states like Ohio and Indiana that can produce twice as many scientists as they have in residence, or quantity production, have something to be proud of in addition to those starred. Whether it is country life, good ancestry, etc., it shows a desirable environment.

Conclusion

In conclusion the 329 scientists still living in Indiana make up what I like to call Indiana's "Fifth Estate." They are not supposed to know much about financial matters (since the depression it is doubtful whether the bankers know either). They are not often trusted to sit in Congress (lately some brain trusters seem to be desirable there), but these are the men and

women who have the ability to generalize, the power to think and the initiative to find a way to do and invent new things. In short, they have the genius to create that which makes life pleasant.

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TOXICITY OF SELENIUM-CONTAINING PLANTS TO APHIDS

IN the course of studies[1] of the effects of selenium on wheat it was noted that aphids, *Rhopalosiphum prunifoliae* (Fitch), did not attack plants injured by selenium in solution cultures or soils. Since both rats and larger animals are able to detect the presence of selenium in their food and are reluctant to eat it,[2] the question arose as to whether the aphids found the selenium absorbed by the plants distasteful and migrated, or whether they died as the result of sucking the selenium-containing juice. The following experiments were accordingly designed to determine their behavior under conditions of artificial infestation.

Nutrient solutions, in 600 cc flasks, were made to contain various concentrations of sodium selenate ranging from amounts so small as to supply but 1 p.p.m. of selenium to concentrations as high as 12 p.p.m. Known numbers of aphids were placed on wheat plants growing in these solutions, and records of survival made daily. By placing each flask in the center of a large saucer of water it was possible to prevent migration and to account for the aphids that dropped from the plants.

Aphids placed on 2-months-old plants supplied with concentrations of selenium greater than 3 p.p.m. all died within a few days, while those with lower concentrations lived for as long as a week, although without reproducing actively. Similar results were observed with the red spider, *Tetranychus telarius* (L.). The plants were stunted by concentrations greater than 3 p.p.m. selenium.

The experiment was repeated with younger plants one month old. Comparatively few aphids survived on the plants grown with but 1 p.p.m. selenium, although some reproduction did take place. No damage to the plants themselves was apparent at this concentration. A few aphids survived for several days on plants supplied with 3 and 4 p.p.m., but did not reproduce. As the selenium concentration increased, it was necessary to add more aphids daily in an attempt to keep the plants infested with living aphids. Only on the control plants without selenium did the insects live and multiply normally.

The aphids were evidently sensitive to concentrations of selenium in the plant too low to visibly affect the plant itself. This was also obvious in some experiments with wheat, rye, oats and barley grown in soil treated with sodium selenate at a rate of 10 p.p.m. selenium, a concentration having little effect on the plants but almost completely inhibiting aphid infestation. For some reason more of the aphids persisted on the rye plants than on the others, although here also the number was greatly reduced. Adjacent control plants without selenium were all severely infested.

It is concluded that this species of aphid is killed by selenium taken up by plants from small amounts in the substratum. Evidently concentrations even lower than 10 p.p.m. in the soil would prevent serious attack. Whether or not this sensitiveness can be utilized as a means of insect control, with non-food crops or ornamentals, is problematical in view of the extreme toxicity of selenium to both plants and animals. Certainly the utility of the more readily absorbed selenium salts, such as the sodium selenate used in the experiments reported in the present paper, would seem limited to cases where the land is not to be utilized for food crops or where rapid leaching or irrigation insures complete removal of any residual toxicity.

The toxicity of selenium-containing plants to aphids is in accordance with their singular toxicity to higher animals. Selenium absorbed by vegetation on virgin soils has been shown to be the cause of a sometimes fatal disease of live stock.[3] White rats are injured by concentrations as low as 6 p.p.m. in a diet containing seleniferous grain.[4] The toxicity of selenium has led to various recommendations for its use in insecticides. It has been found especially effective in combatting red spiders,[5] although caution in its use has been urged.[6] It is not recommended by the Department of Agriculture because of the danger of contaminating foodstuffs, and because of a question as to possible injury to the persons making the applications.

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THE RÔLE OF CERTAIN INORGANIC ELEMENTS IN THE CAUSE AND PREVENTION OF PEROSIS

IN carrying on experiments on the cause and prevention of perosis, an anatomical deformity of the

[1] A. M. Hurd-Karrer, *Jour. Agr. Res.*, 49: 343–357, 1934.

[2] K. W. Franke and V. R. Potter, SCIENCE, 83: 330–332, 1936.

[3] K. W. Franke, T. D. Rice, A. G. Johnson and H. W. Schoening, *U. S. Dept. Agr. Circ.* 320, 1934.

[4] H. E. Munsell, G. M. DeVaney and M. H. Kennedy, *U. S. Dept. Agr. Tech. Bull.* (In preparation.)

[5] C. B. Gnadinger, *Ind. Eng. Chem.*, 25: 633–637, 1933.

[6] E. M. Nelson, A. M. Hurd-Karrer and W. O. Robinson, SCIENCE, 78: 124, 1933.

al-metatarsal joint of young chickens, it was found the common c. p. grade of calcium carbonate, roxide and chloride as well as of mono-, di- and tri-ium phosphates and of mono-sodium phosphate ravated the occurrence of this disorder to about same extent as steamed bone meal.

n the other hand, a technical grade of mono-cal-m phosphate actually possessed a preventive rather n a causative effect. A spectroscopic examination this salt showed the presence of considerable man-ese and traces of iron. A qualitative analysis indi-d the presence of aluminum as well. The subse-nt addition of an equivalent amount of manganese, 025 per cent., to a basal diet containing 0.0010 per t. demonstrated that this element was responsible the preventive action of this salt. This amount manganese was found to be quite effective in pre-nting perosis at levels of 1.0 and 1.2 per cent. of calcium and at levels of 0.8 and 1.2 per cent. of phosphorus. The addition of a mixture containing 0.0025 per cent. each of manganese, aluminum and iron was entirely preventive at the lower calcium and phosphorus levels and had a slight beneficial effect on growth. Further results showed that aluminum and zinc had a similar but less effective preventive action. The perosis preventing property of common feed stuffs was roughly in proportion to their manganese content.

It is concluded that perosis is due to the lack of certain inorganic elements, of which manganese is notable, and that its occurrence is aggravated by an excess of calcium and probably of phosphorus.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

RETENTION OF PLANT COLORS

THE writer has for some months been experimenting h a new method of mounting plant material, which ds promise of considerable value, not only to bota-ts, but to entomologists, plant pathologists and rhaps others.

Every economic entomologist needs to keep a small rbarium of well-mounted, properly determined nts, to be associated with his insects collected, as sitive proofs of his host records. The relationships tween insects and plants are so intimate that accu-cy in host records is imperative.

It was from the standpoint of an entomologist that began my work. I have never liked the bulky botani-l mounts, for my own purposes; nor are envelopes proper way to put away record host plants. I have ng felt that there must be some way to mount a wer and preserve its natural color, and yet when I ok at great herbaria I am astonished at the ugly own specimens of what were beautiful plants.

There came to me a thought in the late summer of 935 which has been very productive. For a few onths I had been using the adhesive cellulose tape nown as Scotch cellulose tape, for mounting my lant specimens, so that not even the part covered by e strips was hidden. It was unquestionably a better ay of mounting plants than the old white paper strip ethod.

Just as a hit-and-miss proposition I took a petunia lossom, of a rich purple color, and mounted it while resh directly under the tape, with the lips flared pen; another specimen from side view; and a third t open down one side to show the floral organ ar-rangement. The sheet on which these were mounted was pressed. This was on September 1, 1935. On the following day, to my amazement, the cut-open flower had lost almost all its color, except where there was overlap, but there was only one change in the other two. The veins in the petals had become lightened and very distinct. These specimens have at present writing held color for eleven months.

The next trial was of a very blue new species of Commelina, a most difficult flower to press or hold colors in. Mounted on September 27, 1935, the blue color has held perfectly for over ten months.

Since that time numerous flowers of as many colors as I could find have been mounted, with varying results.

The essential point in holding the color is cutting off the air. If the mount is too thick, there is likely to be more or less loss of color.

Outstanding successes in color holding have been obtained with the delicate pink of the cranberry; the even more delicate pink of *Drosera filiformis;* the delicate blue of toad flax, *Linaria canadensis;* the rose red of *Kalmia angustifolia;* the green leaves and yellow flowers of *Baptisia tinctoria;* the yellow of the dandelion; the white of Spirea; the creamy yellow of Lonicera, bush honeysuckle; the yellow of an iris with short standards; the yellow of *Oxalis filipes;* yellow of Coreopsis and Calliopsis; purplish blue of Delphinium; purplish red of bergamot; orange of *Cynthia virginica;* the creamy pink of *Azalea viscosa;* yellow of *Hieracium venosum;* creamy white of mock orange; brilliant yellow of Oenothera; white of *Sabatia lanceolata;* and other yellow flowers.

Results not quite so perfect and yet very encourag-

ing, which would probably be improved by the next method to be mentioned, were obtained with the beautiful pink *Limnodorum tuberosum;* the rich purplish rose of *Rhexia virginica;* the delicate pink of *Pogonia ophioglossoides;* the orange of *Hemerocallis fulva;* the rose pink of *Cydonia japonica;* pink Weigela; purple of Siberian iris; scarlet and pink roses; various colors of Dianthus; a purplish red Azalea; light blue violet.

All the above results were obtained by simply covering the flower on a plain cardboard, 4 × 6 inch, with overlapping strips of Scotch cellulose tape pressed smoothly and tightly. They were dried by placing between blotting papers in a pack of cards and pressed merely by rubber bands. This makes the method available to any field man, for he can carry all his equipment in a small collecting bag, or his pockets.

The botanist desiring a larger herbarium specimen can also make up in the field a card of fresh specimens for color holding, and also for showing permanently the internal plant organs. A dissected flower or two mounted on the card does away forever with the necessity of relaxing and dissecting the herbarium specimens. Flowers mounted this way have the petals and floral organs spread out more or less perfectly and will not shrivel. The greens of the leaves are holding splendidly in the oldest mounts.

Some flowers apparently contain chemicals which react to the rubber glue on the tape. The African violet in a few minutes becomes perfectly colorless transparent, and shows all the veins in the petals. *Sisyrynchium graminoides* also reacts immediately and becomes colorless. So also does the yellow Portulaca, except for the brighter orange center. I decided therefore to try another method, and covered the flower with a square of plain Cellophane, and sealed this down with the adhesive tape. The African violet, when not touched by the fingers, and the yellow portulaca then gave very successful results.

It is well known that *Baptisia tinctoria* turns black, but if the card is first covered with Dennison's transparent tape, and the flowers then mounted under the Scotch cellulose tape, and no pressing whatever administered, the color is held.

Now the method is also available to the entomologist for mounting leaf mines, and for extra evidence a miner larva, extracted and gently pressed, will be preserved beside its work.

Likewise, he can mount specimens of leaves showing typical injuries, and these cards mounted in a notebook can go into the library. In fact, my whole herbarium is in small notebooks, looseleaf, ten-cent binders.

In cases of aphids, scales, red spiders, lace-bugs, etc., the insect should be left right on the leaf where it did its injury and the adhesive prevents its mov so that it dies in position. The color of the in and cause are present as permanent records, ea studied under a binocular.

To the economic entomologist the method car peculiar advantage. In spraying operations i often desirable to have a permanent record of nature of the coverage of the poison. If this is vis on the leaf when mounted under the adhesive tape will always be there for proof. In this way standa of coverage could be worked out and a field man co carry a sample set of standard cards, to match up w field behavior.

The plant pathologist will find that the brilli colors of diseased leaves hold color splendidly. can take a flower head with smut and lay it gently a card and seal it under the tape for a perman specimen that will not endanger anything else. I h found no fungous growth under tightly sealed, quic dried specimens. When the plant material is full moisture it is of advantage to dry upside down un a lamp.

The criminologist may also find use for the syst Having in his pocket a pack of 4 × 6 cards and a f rolls of adhesive tape he can lay down on a ca fragments of dust, ash, pieces of leaf, hairs, ma other delicate little evidences and seal them for p manent evidence, always available for study under t microscope. Such materials mounted on the spot a attested on the spot by a second witness should h added value in court.

The method is also available for mounting of ins wings.

There are various thicknesses of Cellophane, a many specimens could be mounted under the tape Cellophane cards and be available for study on bo sides.

W. DWIGHT PIERCE

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